

WHAT IS CLAIMED IS:

1. A method of making a free-standing, internally-supported, three-dimensional object, the outer surface of the object comprising a plurality of intersecting facets, at least a sub-set of said intersecting facets having a diamond layer of substantially uniform depth, said method comprising the steps of:

(a) providing a mold having an exposed surface defining the sub-set of intersecting facets;

(b) growing a diamond layer of substantially uniform depth over the exposed surface;

(c) depositing a backing layer over at least a portion of the diamond layer; and

(d) removing the mold to expose the surface of the diamond layer grown immediately contiguous to the mold.

2. The method of Claim 1 wherein the mold is a silicon substrate fabricated to define the sub-set of intersecting facets.

3. The method of Claim 2 wherein the mold is removed by chemical etching.

4. The method of Claim 1 further including the step of pretreating the exposed surface of the mold to enhance the growth of the diamond layer.

5. The method of Claim 4 wherein carbon atoms are deposited on the exposed surface of the mold to enhance the growth of the diamond layer.

6. The method of Claim 5 wherein the carbon atoms are deposited on the exposed surface of the mold by exposing the surface to a carbon containing plasma.

7. The method of Claim 1 wherein the sub-set of intersecting facets includes planar facets.

8. The method of Claim 1 wherein the sub-set of intersecting facets includes non-planar facets.

9. A method of fabricating a free-standing object comprising a three-dimensional structure covered by a diamond film having an exposed surface, said method comprising the steps of:

growing a diamond film on a preselected exposed surface of a substrate;
providing a backing on at least a portion of the grown diamond film; and
removing the substrate to expose the diamond surface defined by the preselected surface of the substrate on which the diamond was grown.

10. The method of Claim 9 wherein the substrate is silicon.

11. The method of Claim 9 including the further step of pretreating the preselected exposed surface to enhance the growth of diamond thereon.

12. The method of Claim 11 wherein a carbon seed layer is formed on the preselected exposed surface of the substrate.

13. The method of Claim 9 wherein the preselected surface of the substrate includes the intersection of two facets.

14. A method of fabricating a free-standing, internally-supported, three-dimensional object, the outer surface of the object comprising a plurality of intersecting facets, at least a sub-set of said intersecting facets having an exposed diamond surface, said method comprising the steps of:

growing a diamond film on a preselected exposed surface of a substrate;
providing a backing layer covering at least a portion of the grown diamond film;
and
removing the substrate so that the exposed diamond surface is the surface grown immediately contiguous to the substrate.

15. The method of Claim 14 wherein the substrate is silicon.
16. The method of Claim 15 wherein the substrate is removed by chemical etching.
17. The method of Claim 14 wherein the backing layer covers the entire diamond film.
18. The method of Claim 14 wherein the backing layer is electrically conducting.
19. The method of Claim 14 wherein the backing layer is electrically non-conducting.
20. The method of Claim 19 wherein the backing layer is epoxy.
21. The method of Claim 14 including the further step of forming a carbon seed layer on the preselected exposed surface of the substrate to facilitate the growth of the diamond film thereon.
22. The method of Claim 21 wherein the diamond seed layer is formed by exposing the preselected exposed surface of the substrate to a carbon containing activated gas.

23. The method of Claim 22 wherein the diamond seed layer is formed by:
grounding the substrate;
providing ionized carbon atoms; and
exposing the preselected exposed surface of the substrate to the ionized carbon atoms.
24. The method of Claim 22 wherein the activated gas is a plasma.
25. The method of Claim 24 wherein the plasma is formed by energizing a mixture of hydrogen and hydrocarbon gases.
26. The method of Claim 22 wherein the diamond seed layer is formed by chemical vapor deposition.
27. The method of Claim 14 wherein the diamond is grown by chemical vapor deposition.
28. The method of Claim 14 wherein the intersecting facets include planar facets.
29. The method of Claim 14 wherein the intersecting facets include non-planar facets.
30. The method of Claim 14 wherein the exposed diamond surface forms the surface of a waveguide.
31. The method of Claim 14 wherein the object is a bi-polar plate for a fuel cell.
32. A method of making a free-standing, internally-supported, three-dimensional object, the outer surface of the object comprising a plurality of intersecting

facets, at least a sub-set of said intersecting facets having a diamond layer of substantially uniform depth, said method comprising the steps of:

- (a) fabricating a silicon substrate to provide a molding surface defining the sub-set of intersecting facets;
- (b) seeding the molding surface of the substrate with carbon;
- (c) growing a diamond layer of substantially uniform depth over the molding surface of the substrate;
- (d) forming an internally-supporting backing layer over the diamond layer; and
- (e) chemically etching the substrate to expose the surface of the diamond layer grown contiguous to the molding surface of the substrate.

33. The method of Claim 32 wherein molding surface is seeded by chemical vapor deposition.

34. The method of Claim 32 wherein the diamond layer is grown by chemical vapor deposition.